

# PATENT COOPERATION TREATY

From the  
INTERNATIONAL SEARCHING AUTHORITY

## PCT

WRITTEN OPINION OF THE  
INTERNATIONAL SEARCHING AUTHORITY  
(PCT Rule 43bis.1)

To:

see form PCT/ISA/220

Date of mailing  
(day/month/year) see form PCT/ISA/210 (second sheet)

Applicant's or agent's file reference  
see form PCT/ISA/220

**FOR FURTHER ACTION**  
See paragraph 2 below

International application No.  
PCT/GB2004/004413

International filing date (day/month/year)  
18.10.2004

Priority date (day/month/year)  
31.10.2003

International Patent Classification (IPC) or both national classification and IPC  
C07C67/08, C07C69/60, C07C29/17

Applicant  
DAVY PROCESS TECHNOLOGY LIMITED

1. This opinion contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☐ Box No. II Priority
- ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☐ Box No. VII Certain defects in the International application
- ☐ Box No. VIII Certain observations on the International application

2. **FURTHER ACTION**

If a demand for international preliminary examination is made, this opinion will usually be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA"). However, this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1bis(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of three months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

3. For further details, see notes to Form PCT/ISA/220.

Name and mailing address of the ISA:



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**WRITTEN OPINION OF THE  
INTERNATIONAL SEARCHING AUTHORITY**

International application No.  
PCT/GB2004/004413

**Box No. 1 Basis of the opinion**

1. With regard to the language, this opinion has been established on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.
  - ☐ This opinion has been established on the basis of a translation from the original language into the following language , which is the language of a translation furnished for the purposes of international search (under Rules 12.3 and 23.1(b)).
2. With regard to any nucleotide and/or amino acid sequence disclosed in the international application and necessary to the claimed invention, this opinion has been established on the basis of:
  - a. type of material:
    - ☐ a sequence listing
    - ☐ table(s) related to the sequence listing
  - b. format of material:
    - ☐ in written format
    - ☐ in computer readable form
  - c. time of filing/furnishing:
    - ☐ contained in the international application as filed.
    - ☐ filed together with the international application in computer readable form.
    - ☐ furnished subsequently to this Authority for the purposes of search.
3. ☐ In addition, in the case that more than one version or copy of a sequence listing and/or table relating thereto has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.
4. Additional comments:

**WRITTEN OPINION OF THE  
INTERNATIONAL SEARCHING AUTHORITY**

International application No.  
PCT/GB2004/004413

**Box No. V Reasoned statement under Rule 43b/s.1(a)(I) with regard to novelty, inventive step or  
industrial applicability; citations and explanations supporting such statement**

**1. Statement**

Novelty (N)

Yes: Claims 3,11,14,22  
No: Claims 1-2,4-10,12,13,15-21

Inventive step (IS)

Yes: Claims  
No: Claims 1-22

Industrial applicability (IA)

Yes: Claims 1-22  
No: Claims

**2. Citations and explanations**

**see separate sheet**

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**Re Item V.**

1. The following document is referred to in this communication :

D1: US-A-4 032 458 (COOLEY STONE D ET AL) 28 June 1977  
D2: GB-A-1 437 898 (PETRO TEX CHEM CORP) 3 June 1976  
D3: US-A-2 610 206 (EDWARD SALT FRANCIS ET AL) 9 September 1952  
D4: WO 93/00440 A (DU PONT) 7 January 1993  
D5: DE 32 22 837 A (HOECHST AG) 22 December 1983  
D6: DD 206 373 A (FRANKE JOACHIM; GABSCH GUENTHER; THIEME  
IRMGARD) 25 January 1984

2. Novelty

2.1 The document D1 discloses (cf. the international search report) a continuous process for the production of dialkyl maleates from an aqueous solution containing 10-60 wt. % of maleic acid obtained by scrubbing the reactor effluent of an oxidative production of maleic anhydride with water. The esterification is performed as a single-stage process in a reactive distillation column using the alcohol to remove the water of solution and the reaction water azeotropically. The dialkyl maleate product (comprising some dialkyl fumarate) is subsequently hydrogenated to 1,4-butanediol.

The subject-matter of claims 1, 2, 4, 5, 7, 10, 12 and 16-21 is therefore not novel (Article 33(2) PCT).

2.2 The document D2 discloses (cf. the international search report) a continuous process for the production of dialkyl maleates from an aqueous solution containing 30-60 wt. % of maleic acid obtained by scrubbing the reactor effluent of an oxidative production of maleic anhydride with water. The esterification is performed as a two-stage process using the alcohol to remove the water of solution and the reaction water azeotropically in the first stage.

The subject-matter of claims 1, 2, 4, 5, 7-10, 12, 13, 20 and 21 is therefore not novel (Article 33(2) PCT).

2.3 The document D3 discloses (cf. the international search report) a continuous

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process for the esterification of aqueous lactic acid and methanol catalysed by PTSA, using a tubular reactor.

The subject-matter of claims 1, 2, 4 and 13 is therefore not novel (Article 33(2) PCT).

2.4 The document D4 discloses (cf. the international search report) a sulphuric acid catalysed esterification of lactic acid in a concentrated aqueous fermentation broth and simultaneous removal of water with butanol (continuous or batch process).

The document D5 discloses (cf. the international search report) a process for the preparation of methyl lactate from an aqueous solution of lactic acid which is concentrated up to about 96 % prior to the esterification.

The document D6 discloses (cf. the international search report) a sulphuric acid catalysed esterification of aqueous lactic acid in a specially adapted vacuum reboiler.

The subject-matter of claims 1, 2, 4, 6, 12, 13 and 15 is therefore not novel (Article 33(2) PCT).

2.5 Dependent claims can only meet the PCT requirements when related to independent claims complying with Article 33 (1) PCT.

### 3. Preliminary remarks concerning the Inventive Step

3.1 It is already known from D1 (single stage esterification, reduction to 1,4-butanediol) and D2 (two-stage esterification) to overcome problems related to fumaric acid (clogging) by esterifying an aqueous solution. It is also obvious that both maleates and fumarates will yield the same hydrogenation product (1,4-butanediol).

A reduction of the water content prior to the esterification is an obvious process step and is known from the prior art (e. g. D4 and D5). The skilled person would regard it as the result of routine work to reuse the reaction water of the esterification in the preparation of an aqueous solution or to reuse the alcohol

obtained in the hydrogenation in the esterification stage when applicable in order to minimise the production costs and the amount of waste. The use of an esterification catalyst is a routine step.

Even if novelty can be reestablished over the prior art, an inventive step could be acknowledged, therefore, only if an unexpected improvement can be shown, resulting from the technical differences to the prior art. It would be necessary that such a technical effect could be expected over the whole scope of claim 1.

3.2 The dependent claim do not contain any features which, in combination with the features of any claim to which they refer, meet the requirements of the PCT in respect of the inventive step.

4. 4.1 The applicant is requested to file amendments by way of replacement pages in the manner stipulated by Rule 66.8(a) PCT. In particular, fair copies of the amendments should be filed preferably in triplicate.

In order to facilitate the examination of the conformity of the amended application with the requirements of Article 34(2)(b) PCT, the applicant is requested to clearly identify the amendments carried out, no matter whether they concern amendments by addition, replacement or deletion, and to indicate the passages of the application as filed on which these amendments are based (see also Rule 66.8(a) PCT).

If the applicant regards it as appropriate these indications could be submitted in handwritten form on a copy of the relevant parts of the application as filed.

4.2 Any information the applicant may wish to submit concerning the subject-matter of the invention, for example further details of its advantages or of the problem it solves, and for which there is no basis in the application as filed, should be confined to the letter of reply and not be incorporated into the application (Article 34(2)(b) PCT).

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